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EXERCISES IN ZOOLOGY

CLASS 590 BOOK K283

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EXERCISES IN ZOOLOGY

ARRANGED FOR THE

ZOOLOGICAL LABORATORY

OF THE

PHILADELPHIA HIGH SCHOOL FOR GIRLS

BY

IDA A. KELLER, Ph.D.

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1906

Press of
The New Era Printing Company
Lancaster, Pa.

CLASSIFICATION.

PENNSYLVANIA STATE LIBRARY

- Protozoa or Monoplastida.
  1. Phylum: Protozoa.
     1. Class: Rhizopoda.
     2. Class: Sporozoa.
     3. Class: Infusoria.
- Metazoa or Polyplastida.
  2. Phylum: Porifera.
  3. Phylum: Cœlenterata.
     1. Class: Hydrozoa.
     2. Class: Scyphozoa.
  4. Phylum: Vermes.
     1. Subphylum: Plathelminthes.
     2. Subphylum: Cœlhelminthes.
  5. Phylum: Arthropoda.
     1. Class: Crustacea.
        1. Subclass: Entomostraca.
        2. Subclass: Malacostraca.
        3. Subclass: Gigantostraca.
     2. Class: Arachnoidea.
     3. Class: Onychophora.
     4. Class: Myriopoda.
     5. Class: Insecta.
        1. Order: Thysanura.
        2. Order: Ephemerida.
        3. Order: Odonata.
        4. Order: Orthoptera.
        5. Order: Hemiptera.
        6. Order: Neuroptera.
        7. Order: Trichoptera.
        8. Order: Lepidoptera.
        9. Order: Diptera.
        10. Order: Siphonaptera.
        11. Order: Coleoptera.
        12. Order: Hymenoptera.
  6. Phylum: Mollusca.
     1. Class: Gastropoda.
     2. Class: Acephala.
     3. Class: Cephalopoda
  7. Phylum: Echinodermata.
     1. Class: Crinoidea.
     2. Class: Asteroidea.
     3. Class: Ophiuroidea.
     4. Class: Echinoidea.
     5. Class: Holothuroidea.
  8. Phylum: Chordata.
     1. Subphylum: Tunicata.
     2. Subphylum: Cephalochordia.
     3. Subphylum: Vertebrata.
        - A. Pinnata.

280820

CLASSIFICATION.

1. Class : Pisces.
    1. Subclass : Elasmobranchii.
    2. Subclass : Teleostomi.
    3. Subclass : Dipnoi.

B. Digitata.

2. Class : Amphibia.
    1. Order : Urodela.
    2. Order : Anura.
3. Class : Reptilia.
    1. Order : Sauria.
    2. Order : Ophidia.
    3. Order : Crocodilia.
    4. Order : Chelonia.
4. Class : Aves.
    - A. Subclass : Carinatæ.
        1. Order : Pygopodes.
        2. Order : Longipennes.
        3. Order : Tubinares.
        4. Order : Steganopodes.
        5. Order : Anseres.
        6. Order : Odontoglossæ.
        7. Order : Heriodones.
        8. Order : Paludicolæ.
        9. Order : Limicolæ.
        10. Order : Gallinæ.
        11. Order : Columbæ.
        12. Order : Raptores.
        13. Order : Psittaci.
        14. Order : Coccyges.
        15. Order : Pici.
        16. Order : Macrochires.
        17. Order : Passeres.
    - B. Subclass : Ratitæ.
        18. Order : Cursores.
5. Class : Mammalia.
    1. Order : Monotremata.
    2. Order : Marsupialia.
    3. Order : Edentata.
    4. Order : Cetacea.
    5. Order : Sirenia.
    6. Order : Ungulata.
    7. Order : Rodentia.
    8. Order : Insectivora.
    9. Order : Chiroptera.
    10. Order : Carnivora.
    11. Order : Primates.
        1. Suborder : Prosimii.
        2. Suborder : Simiæ.
        3. Suborder : Anthropidæ.

PROTOZOA.

PROTOZOA.

DRAWINGS.

PROTOZOA.

Phylum Protozoa (   )

Amœba (   )

Degree of specialization....

Locomotion....

Reproduction....

Paramœcium (   )

Degree of specialization....

Locomotion....

Reproduction....

Vorticella (   )

Degree of specialization....

Locomotion....

Reproduction....

1. Class: Rhizopoda ( )....

2. Class: Sporozoa ( )....

3. Class: Infusoria ( )....

Characteristics of Phylum....

References:

Leidy, Fresh Water Rhizopods,

Other references....

PORIFERA.

PORIFERA.

DRAWINGS.

PORIFERA.

Phylum Porifera ( ). Grantia.

General form and appearance....

Openings to exterior:

Exhalent pore (osculum)....

Inhalent pores....

Skeleton....

Method of obtaining food....

Sponges are classified according to character of skeleton:

1. Calcareous Sponges....
2. Siliceous Sponges....
3. Horny Sponges....

PORIFERA.

Characteristics of Phylum:

Three body layers. . . .

Degree of specialization. . . .

Reproduction and Development. . .

Gemmules of Fresh Water Sponges. . . .

Distribution, Habitat and Commercial Importance. . . .

References:

Potts' Fresh Water Sponges.

Other References. . . .

CŒLENTERATA.

CŒLENTERATA.

HYDROZOA.

CŒLENTERATA.

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Phylum Cœlenterata ( )

THE HYDRA.

Shape and symmetry....

Tentacles....

Mouth....

STUDY OF LONGITUDINAL SECTION.

Layers of body:

a. Ectoderm....

b. Endoderm....

c. Mesoglœa....

Reproduction:

a. Sexual....

b. Asexual

Degree of specialization....

280820

Locomotion....

CŒLENTERATA.

HYDROZOA.

CŒLENTERATA.

HYDROID COLONIES.

Formation. . . .

Division of Labor. . . .

Reproduction. . . .

Alternation of Generations. . . .

How may a medusa be derived from a simple hydranth? . . . .

CŒLENTERATA.

SCYPHOZOA.

CŒLENTERATA.

Phylum Cœlenterata.

1. Class: Hydrozoa ( )

Includes:

Hydra and Hydroid Colonies....

Siphonophora....

Characteristics of Class....

Distribution and habitat....

Degree of specialization....

2. Class: Scyphozoa ( )

Includes:

Sea Anemone....

Coral....

Jelly-fish....

Characteristics of Class:

Distribution, habitat and other points....

CŒLENTERATA.

Characteristics of Phylum:

Symmetry....

Body layers....

Stinging Cells....

Digestive Tube....

Habitat and Distribution....

References:

Parker, Elementary Biology.

Beddard, Elementary Zoölogy.

Dana, Corals and Coral Islands.

Romanes, Jelly-fish, Star-fish and Sea-Urchins.

VERMES.

VERMES.

DRAWINGS.

VERMES.

Phylum Vermes ( ). The Earthworm.

Symmetry and segmentation. . . .

Modified somites in prostomium and clitellum. . . .

Antero-posterior differentiation. . . .

Dorso-ventral differentiation. . . .

Openings:

Mouth. . . .

Of seminal receptacles. . . .

Of oviducts. . . .

Of sperm-ducts. . . .

Dorsal pores. . . .

Nephridial pores. . . .

Anus. . . .

Setæ. . . .

INTERNAL ANATOMY.

1. Digestive System:

Mouth. . . .

Pharynx. . . .

Œsophagus. . . .

Crop. . . .

Gizzard. . . .

Stomach-intestine. . . . .

Anus. . . .

Describe processes of digestion and absorption. . . .

2. Circulatory System:

a. Cœlomic circulation. . . .

b. Vascular circulation:

Dorsal vessel. . . .

Sub-intestinal vessel. . . .

Circular or commissural vessels. . . .

Course of blood. . . .

3. Excretory System:

Nephridia. . . .

4. Respiratory System: . . . .

5. Muscular System: . . . .

6. Nervous System:

    a. Supra-œsophageal ganglia. . . .

    b. Circum-œsophageal commissure. . . .

    c. Sub-œsophageal ganglion. . . .

    d. Ventral nerve-cord. . . .

    e. Ganglia of ventral nerve-cord. . . .

    f. Sense organs. . . .

7. Reproductive System:

    Hermaphrodite. . . .

    a. Testes. . . .

    b. Ovaries. . . .

References:

Sedgwick and Wilson, General Biology.

Darwin, Formation of Vegetable Mould.

VERMES.

DRAWINGS.

Phylum Vermes.

1. Subphylum: Plathelminthes ( )

Includes:

Flat Worms (tape-worm etc.)....

Characteristics of Subphylum....

2. Subphylum: Cœlhelminthes ( )

Includes:

Round Worms....

Annelida....

1. Order: Chætopoda ( ). Earth-worm.

Characteristics of Order....

2. Order: Hirudinea ( ). Leech.

Characteristics of Order....

Characteristics of Subphylum....

VERMES.

Characteristics of Phylum:

Segmentation and symmetry....

Cœlome....

Blood Vessels....

Nervous System....

Organs of Excretion....

Reproduction....

Habitat and Distribution....

ADDITIONAL GROUPS.

1. Bryozoa ( )....

2. Rotatoria ( )....

3. Brachiopoda ( )....

References....

ARTHROPODA.

CRUSTACEA.

DRAWINGS.

CRUSTACEA.

Phylum Arthropoda ( )

1. Class: Crustacea ( ). The Crayfish.

Symmetry and segmentation (Metamerism)....

Character and adaptation of exoskeleton....

Regions of body....

Gill chamber....

CEPHALOTHORAX.

Carapace....

Head or Cephalic Region....

Cervical groove....

Rostrum....

Eyes....

Thoracic Region....

ABDOMEN.

Segments....

Drawing of Section of Typical Segment.

CRUSTACEA.

DRAWINGS.

CRUSTACEA.

APPENDAGES OF CRAYFISH.

I. Cephalic Region.

1. Antennules....

2. Antennæ....

3. Mandibles....

4. Maxillæ, first pair ....

5. Maxillæ, second pair....

2. Thoracic Region.

1. First pair of maxillipeds....

2. Second pair of maxillipeds....

3. Third pair of maxillipeds....

4. Chelipeds....

5. First pair of ambulatory legs....

6. Second pair of ambulatory legs....

7. Third pair of ambulatory legs (opening from oviduct)....

8. Fourth pair of ambulatory legs (opening from sperm duct)....

3. Abdominal Region.

6 Pair of Pleopods....

Typical pleopod and modifications of 1st, 2d, and 6th segments....

Telson (with uropods forms tail fin)....

Sense Organs:

Eyes....

Auditory organ....

CRUSTACEA.

INTERNAL ANATOMY.

1. Digestive System:

  a. Mouth....

    Labrum....

    Mandibles....

    Paragnatha....

  b. Œsophagus....

  c. Stomach....

    Cardiac portion. ..

      Gastric mill....

        Lateral teeth....

        Median tooth....

    Pyloric portion (strainer)....

  d. Intestine....

  e. Anus....

  f. Digestive Glands....

    Character of food....

2. Circulatory System:

  a. Heart (ostia)....

  b. Pericardial sinus....

  c. Arteries:

    Anterior:

      Ophthalmic (median)....

      Antennary (pair)....

      Hepatic (pair)....

Posterior:

Dorsal abdominal (median)....

Sternal....

d. Sinuses and spaces....

Colored Diagram of Circulatory System.

3. Respiratory System:

Branchial chamber....

Gills....

Process of respiration....

4. Muscular System....

5. Excretory System:

Antennary or Green Gland....

6. Nervous System:

a. Brain....

b. Œsophageal commissures....

c. Other ganglia....

d. Ventral nerve cord....

e. Fusion of ganglia....

7. Reproductive System:

Sexes separate.

Ovary and oviduct....

Testis and vas deferens....

References:

Parker, Elementary Biology.

Other references....

CRUSTACEA.

DRAWINGS.

CRUSTACEA.

1. Class: Crustacea.

  1. Subclass: Entomostraca ( )

    Includes:

      Branchipus. . . .

      Cyclops. . . .

      Barnacle. . . .

      Trilobita. . . .

  Characteristics of Subclass. . . .

  2. Subclass: Malacostraca ( )

    Includes:

      Beach flea. . . .

      Sowbug. . . .

      Decapoda. . . .

  Characteristics of Subclass. . . .

  3. Subclass: Gigantostraca ( )

    Includes:

      Limulus. . . .

  Characteristics of Subclass. . . .

Characteristics of Class. . . .

References. . . .

ARTHROPODA.

DRAWINGS.

2. Class: Arachnoidea ( )

Includes:

Spiders and scorpions....

Characteristics of Class....

3. Class: Onychophora ( )

Includes:

Peripatus....

Characteristics of Class....

4. Class: Myriopoda ( )

Includes:

Centipede....

Millipede....

Characteristics of Class....

References...

INSECTA.

INSECTA.

5. Class: Insecta ( )

Types studied....

Symmetry and segmentation....

Exoskeleton (explain adaptation)....

Regions....

A. HEAD.

Number of segments....

Neck....

Eyes....

Antennæ....

Mouth parts....

B. THORAX.

Prothorax and appendages....

Mesothorax and appendages....

Metathorax and appendages....

C. ABDOMEN.

Number of segments....

Spiracles....

Auditory organ....

Termination of abdomen....

DRAWINGS.

INTERNAL ANATOMY.

1. Digestive System:

a. Mouth....

b. Œsophagus....

c. Crop....

d. Gizzard....

e. Stomach....

f. Intestine....

g. Anus....

h. Glands....

Salivary....

Gastric Cæca....

2. Circulatory System:

Heart (ostia)....

DIAGRAM OF CIRCULATORY SYSTEM.

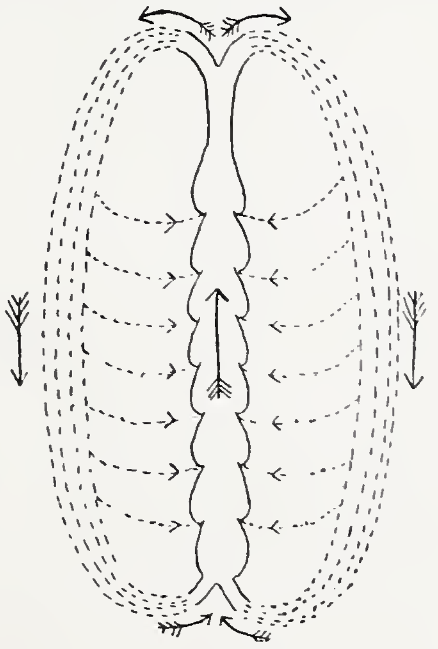

Fig. 1.

Character of blood and account of circulation....

3. Respiratory System.

Spiracles . . . .

Tracheæ . . . .

DIAGRAM OF TRACHEAL SYSTEM.

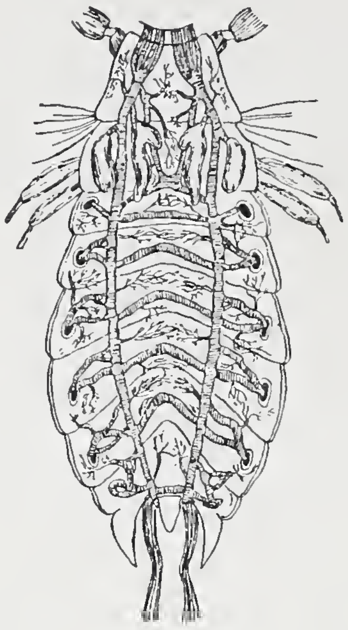

FIG. 2.

Process of Respiration . . . .

4. Muscular System . . . .

5. Excretory System . . . .

Malpighian Tubes . . . .

6. Nervous System. Brain....

Œsophageal commissures....

Other ganglia....

Nerve cord....

7. Reproductive System:

Sexes separate.

Female — Ovaries and oviducts....

Ovipositor....

Male — Testes....

INSECTA.

MOUTH PARTS OF VARIOUS ORDERS.

INSECTA.

WINGS AND LEGS OF VARIOUS ORDERS.

DEVELOPMENT OF INSECTA.

Egg....

Nymph....

Larva (   )....

Pupa....

Chrysalid (   )....

Cocoon (   )....

Imago (   )....

Metamorphosis....

1. Development without metamorphoses....

2. Development with metamorphosis....
   A. Complete Metamorphosis....

   B. Incomplete Metamorphosis....

Molting....

5. Class: Insecta.

1. Order: Thysanura (   )

Includes:

Silver-fish (Fish-moth)....

Springtail....

Characteristics of Order:

Mouth parts....

Development (no metamorphosis). Wings....

Habits and habitat....

2. Order: Ephemerida (   )

Includes:

May-fly....

Characteristics of Order:

Mouth parts....

Wings....

Development (incomplete metamorphosis).

3. Order: Odonata (   )

Includes:

Damsel-fly....

Dragon-fly....

Characteristics of Order:

Mouth parts....

Metamorphosis (incomplete).

Wings....

4. Order: Orthoptera ( )

Includes:

Roach ....

Praying-mantis....

Walking-stick....

True Locusts....

True Grasshoppers and Katydid....

Cricket....

Characteristics of Order:

Mouth parts....

Metamorphosis (incomplete).

Wings....

INSECTA.

ORTHOPTERA.

5. Order: Hemiptera ( )

a. Suborder: Heteroptera ( )

Includes:

Water-boatman. . .

Back-swimmer. . . .

Giant Water-bug. . . .

Water-strider . . .

Assassin-bug. . . .

Lace-bug. . . .

Bed-bug. . . .

Squash-bug. . . .

Stink-bug. . . .

Characteristics of Suborder:

Mouth parts. . . .

Wings. . . .

Metamorphosis. . . .

b. Suborder: Homoptera ( )

Includes:

Cicada....

Tree-hopper....

Plant-lice or Aphids....

Scale-bug....

Characteristics of Suborder:

Mouth parts....

Wings....

Metamorphosis....

c. Suborder: Parasita ( )

Includes:

Lice (parasitic on mammals)....

Characteristics of Suborder:

Mouth parts....

Wings....

Metamorphosis....

Characteristics of Order:

Mouth parts....

Wings....

Metamorphosis....

6. Order: Neuroptera ( )

Includes:

Dobson....

Aphis-lion....

Ant-lion....

Characteristics of Order:

Mouth parts....

Wings....

Metamorphosis....

7. Order: Trichoptera ( )

Includes:

Caddice-worm or Caddice-fly....

Characteristics of Order:

Mouth parts....

Wings....

Metamorphosis....

8. Order: Lepidoptera ( )

Includes:

Moths (On what do the larvæ feed?)....

Skippers (On what do the larvæ feed?)....

Butterflies (On what do the larvæ feed?)....

INSECTA.

LEPIDOPTERA.

INSECTA.

LEPIDOPTERA.

Characteristics of Order:

Mouth parts. . . .

Wings. . . .

Metamorphosis. . . .

9. Order: Diptera ( )

Includes:

Crane-fly. . . .

Mosquito. . . .

Midge. . . .

Gall-gnat. . . .

Horse-fly. . . .

Robber-fly. . . .

Bee-fly. . . .

House-fly. . . .

Blow-fly. . . .

Characteristics of Order:

Mouth parts. . . .

Wings and halteres. . . .

Metamorphosis (especially of mosquito). . . .

10. Order: Siphonaptera ( )

Includes:

Flea....

Characteristics of Order:

Mouth parts....

No wings....

Metamorphosis....

Habits and habitat....

11. Order: Coleoptera ( )

Includes:

Tiger-beetle....

Ground-beetles....

Predaceous diving-beetles....

Wirligig....

Water-scavenger....

Burying-beetles....

Lady-bug....

Click-beetle....

Metallic Wood-borer....

Fire-fly....

Stag-beetle....

Tumble-bugs....

May-beetle....

Rose-bug....

Spotted Pelidnota....

Flower-beetles....

Prionid....

Cloaked Knotty-horn....

Maple-borer....

Sawyer....

Colorado Potato-beetle....

Tortoise-beetle....

Blister-beetle....

Weevils....

Characteristics of Order:

Mouth parts....

Wings....

Metamorphosis....

12. Order: Hymenoptera ( )

Includes:

Bees. . . .

Wasps. . . .

Ants. . . .

Characteristics of Order:

Mouth parts. . . .

Wings. . . .

Metamorphosis. . . .

Sting. . . .

Characteristics of Class Insecta:

Divisions of body.

Head....

Eyes....

Antennæ....

Mouth parts....

Thorax....

Prothorax (appendages)....

Mesothorax (appendages)....

Metathorax (appendages)....

Abdomen....

Organs of respiration....

Heart....

Nervous system and sense organs....

Organs of excretion (Malpighian tubes)....

Development....

Subjects for Papers:
Degeneration and Parasitism.
Economics of each Order.
Mimicry and Protective Coloration.
Social Communities.

Reference Books.
Comstock, Insect Life.
Jordan and Kellogg, Animal Life.
Cheshire, Bees and Bee-keeping.
Cowan, The Honey Bee.
Maeterlink, The Life of the Bee.

Make a classified list of your Insect Collection....

ARTHROPODA.

Characteristics of Phylum:

Symmetry and segmentation....

Appendages....

Nervous System....

Cœlome and Circulatory System....

MOLLUSCA.

MOLLUSCA.

DRAWINGS.

Phylum Mollusca ( ). The Clam.

Symmetry and segmentation....

Exoskeleton (shell).
    Holding shell with end pointing from you.
        Right valve.
        Left valve.
        Anterior end (end pointing from you).
        Posterior end.
        Dorsal margin (upper). Hinge line and hinge ligament.
        Ventral margin.
    Chemical composition of shell. Layers:
        1. Epidermis (conchiolin).

        2. Prismatic layer....

        3. Mother of Pearl....

    Umbo or beak....

    Lines of growth....

Interior of shell.

Hinge-teeth....

Pallial line and pallial sinus....

Muscle impressions. Anterior and posterior....

Toothed edge....

Explain mechanism of opening and closing of shell....

INTERNAL ANATOMY.

Mantle....

a. Siphons....

b. Mantle cavity....

CROSS SECTIONS OF CLAM.

1. Digestive System:
    - *a.* Mouth and labial palps....
    - *b.* Œsophagus....
    - *c.* Stomach and digestive glands....
    - *d.* Intestine....
    - *e.* Rectum....
    - *f.* Anus.....

2. Circulatory System:

a. Heart (chambers)....

Pericardium (represents cœlome)....

b. Aortæ....

c. Arteries....

d. Vena cava....

e. Sinuses....

Colored Diagram of Circulatory System.

Account of circulation....

3. Respiratory System:

Gills (number and structure)....

Process of respiration....

4. Muscular System:

Adductors (anterior and posterior)....

Muscles of foot (retractors and protractor)....

Pallial muscles....

Siphon muscles....

5. Excretory System:

Organ of Bojanus....

Keber's Organ....

6. Nervous System:

a. Cerebro-pleural ganglia....

b. Pedal ganglia....

c. Visceral ganglia....

d. Connectives....

DIAGRAM OF NERVOUS SYSTEM.

e. Sense Organs....

Osphradium....

Otocyst....

Tactile organs....

7. Reproductive System:
    - Sexes separate.
        - Ovaries and testes paired among coils of intestine.
            - Openings near opening of duct from kidney.

Development....

Compare Clam and Oyster....

MOLLUSCA.

GASTROPODA.

MOLLUSCA.

ACEPHALA.

MOLLUSCA.

CEPHALOPODA.

Phylum Mollusca.

1. Class: Gastropoda (   )
Includes:

Snail....

Slug....

Characteristics of Class:

Symmetry....

Head and lingual ribbon....

Eyes and tentacles....

Foot....

2. Class: Acephala (   )

Includes:

Characteristics of Class:

Symmetry....

Head....

Foot....

Mantle....

3. Class: Cephalopoda ( )

Includes:

Squid....

Cuttle-fish....

Pearly Nautilus....

Octopus....

Characteristics of Class:

Head, beak, lingual ribbon, and eyes....

Foot and siphon....

Skeleton....

Chromatophores....

Characteristics of Phylum:

Texture of body....

Segmentation and symmetry....

Mantle....

Nervous System....

Distribution....

References:

ECHINODERMATA.

ECHINODERMATA.

Phylum Echinodermata ( ). The Starfish.

Symmetry. . . .

The young is bilaterally symmetrical while in the adult there is a tendency to bilateral symmetry.

Disk with five rays or arms.

Exoskeleton:

Plates or ossicles. . . .

Spines. . . .

Pedicellariæ. . . .

DORSAL SURFACE.

Madreporite. . . .

Anus. . . .

VENTRAL SURFACE.

Mouth. . . .

Ambulacral Groove. . . .

Tube-feet. . . .

INTERNAL ANATOMY.

1. Digestive System:

a. Mouth. . . .

b. Œsophagus. . . .

c. Stomach, cardiac and pyloric portions. . . .

Pyloric Cæca. . . .

d. Intestine. . . .

Intestinal Cæca. . . .

e. Anus. . . .

2. Circulatory System (not well developed):
    - *a.* Ring blood-vessel....
    - *b.* Five radial vessels....
    - *c.* Sinuses....

3. Respiratory System:
    - Respiratory Cæca....

4. Muscular System (well developed):
    - Muscles of stomach....

5. Water-vascular or Ambulacral System:
    - *a.* Madreporite....
    - *b.* Stone-canal....
    - *c.* Ambulacral ring-vessel....
    - *d.* Radial canals....
    - *e.* Polian vessels....
    - *f.* Ampullæ or water sacs....
    - *g.* Tube-feet....
    - Locomotion accomplished....

6. Nervous System:
    - *a.* Nerve-ring....
    - *b.* Radial nerves....
    - *c.* Sense organs....
        - Eye spot....
        - Tentacle....

ECHINODERMATA.

ECHINODERMATA.

Phylum Echinodermata.

1. Class: Crinoidea ( )
Includes:

Feather-star....

Stone-lily....

Characteristics of Class....

2. Class: Asteroidea ( )
Includes:

Star-fish....

Characteristics of Class....

3. Class: Ophiuroidea ( )
Includes:

Brittle-star or Serpent-star....

Characteristics of Class....

4. Class: Echinoidea ( )
Includes:

Sea-urchin....

Characteristics of Class....

5. Class: Holothuroidea ( )
Includes:

Sea-cucumber....

Characteristics of Class....

Characteristics of Phylum....

CHORDATA.

PISCES.

Subphylum Vertebrata.

1. Class: Pisces (   ) Type studied. . . .

DRAWING OF FISH. (Label.) Dotted line indicates dissection.

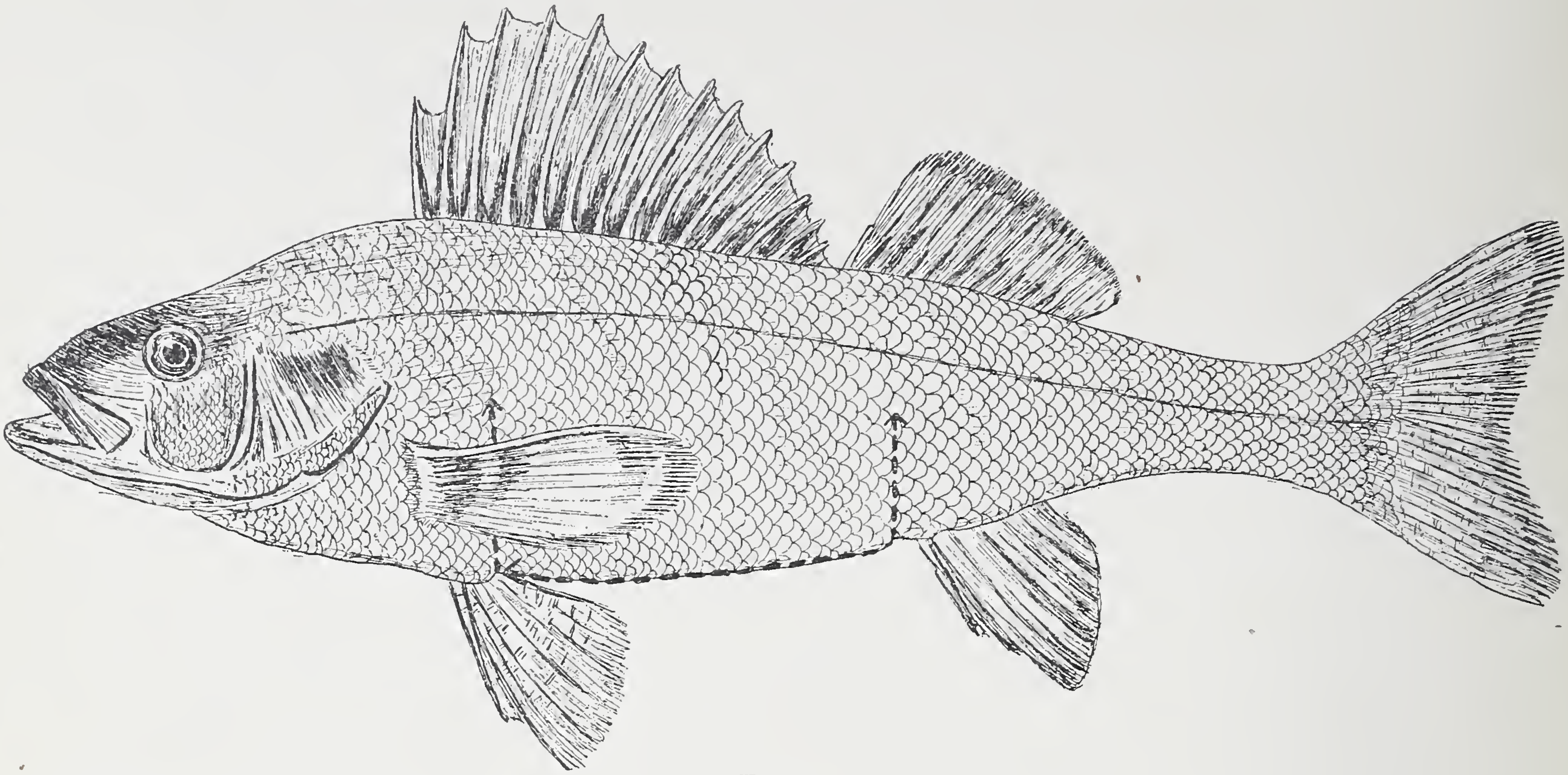

FIG. 3.

1. Body:

General shape and symmetry. . . .

Surfaces, dorsal and ventral. . . .

Covering (scales). . . .

Lateral line. . . .

Urogenital opening, anterior to anal fin.
Anus, anterior to urogenital opening.

2. Appendages (Fins), Number, position, and function:

Pectoral. . . .

Pelvic. . . .

Dorsal. . . .

Anal. . . .

Caudal. . . .

Structure. . . .

3. Head:

a. Mouth....

Upper jaw. Premaxillary....

Maxillary....

Lower jaw. Dentary....

Teeth. Position, character and use....

Tongue....

b. Eyes....

c. Nostrils....

d. Gill cover: (Operculum).

Branchiostegal membrane....

Gill openings....

Gill clefts....

Gills, Number....

Structure....

Central bony arch....

Gill filaments....

Gill rakers....

Blood vessels....

How is respiration accomplished?....

INTERNAL ANATOMY.

Body cavity, mesenteries, and peritoneum....

1. Digestive System:
    a. Alimentary Tract:
        Mouth and tongue....
        Pharynx....
        Œsophagus....
        Stomach....
        Intestine....
        Anus....
    b. Glands:
        Liver and gall bladder....
        Pyloric Cæca....
2. Circulatory System:

DIAGRAM OF CIRCULATION OF FISH. (Color and Label.)

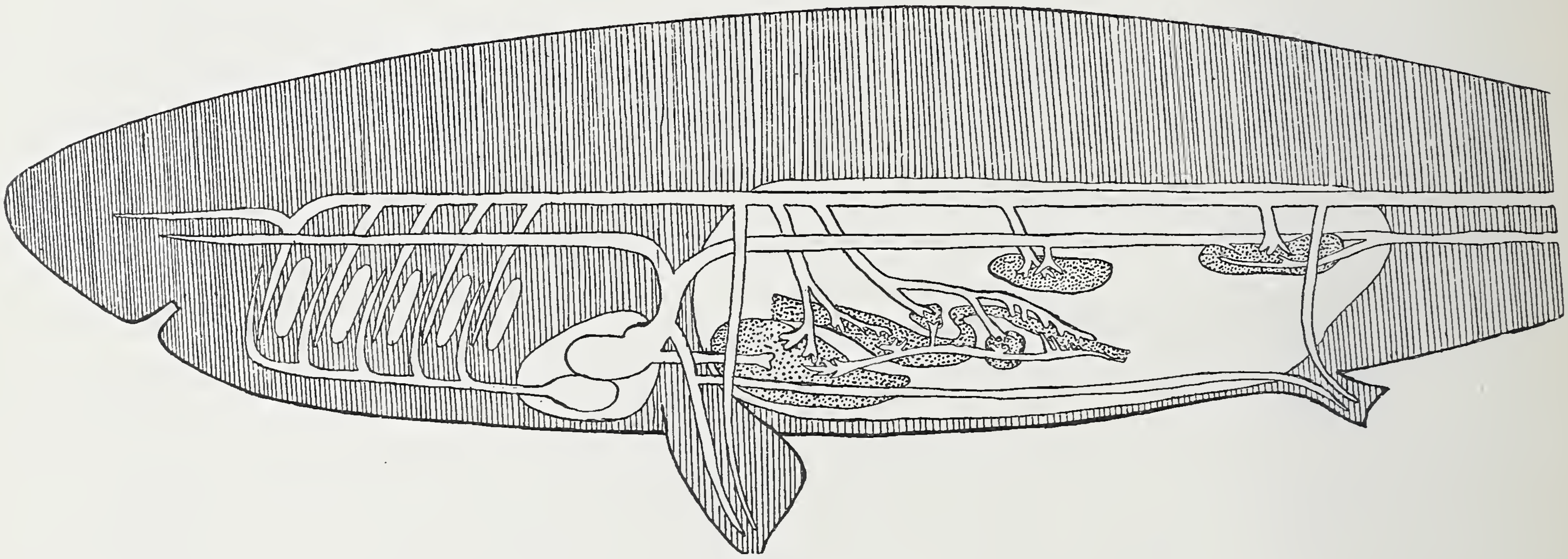

Fig. 4.

Heart (Chambers)....

Blood, blood vessels, and blood temperature....

Account of circulation....

3. Respiratory System (review)....

4. Muscular System....

5. Excretory System....

  Kidneys....

  Urinary bladder and duct....

6. Nervous System:

NERVOUS SYSTEM OF FISH. (Label the most important nerves.)

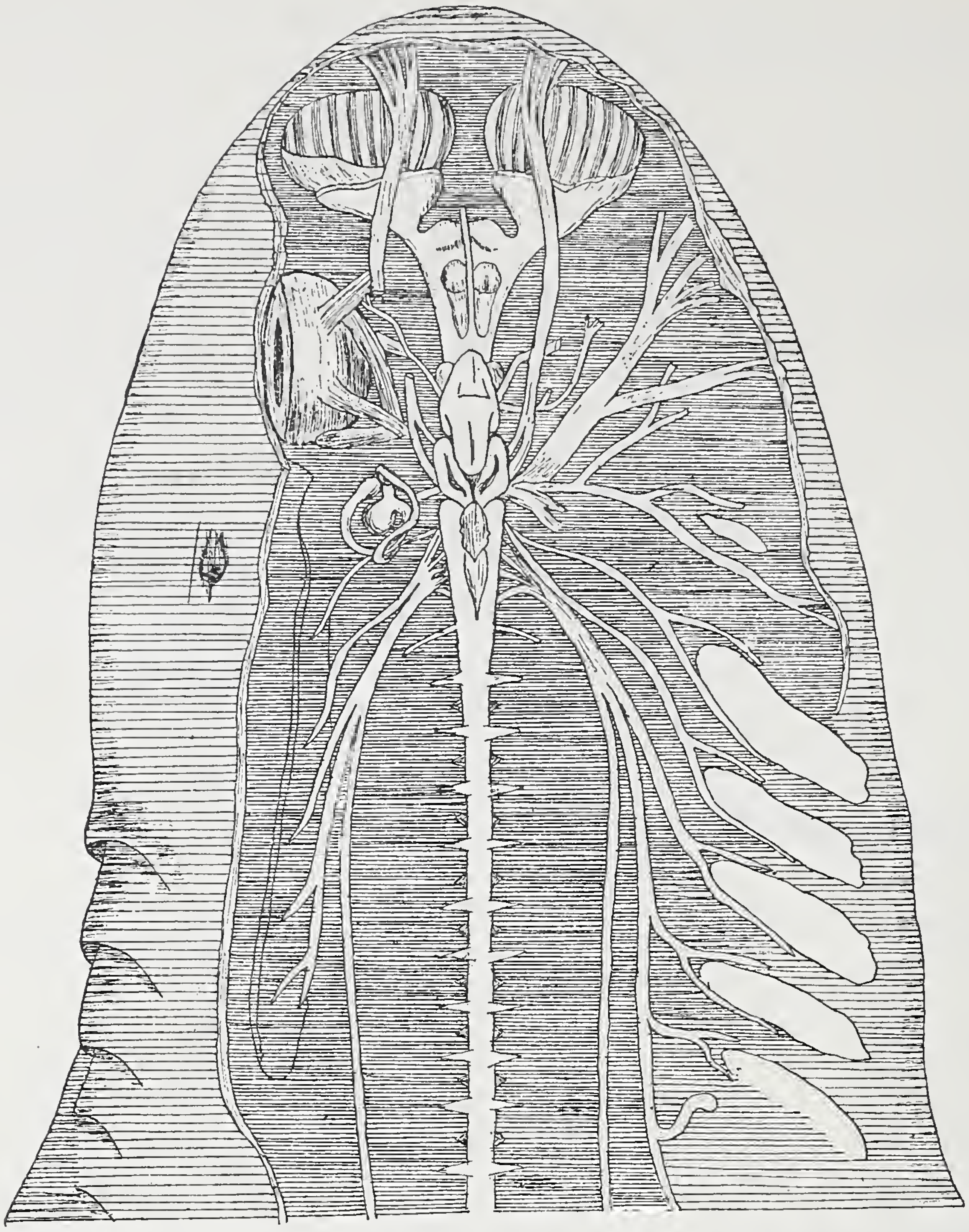

Fig. 5.

7. Reproductive System:

Ovaries....

Testes....

8. Air Bladder....

9. Spleen....

References:
J. T. Parker, Elementary Biology.

Other references....

PISCES.

1. Class: Pisces.

1. Subclass: Elasmobranchii ( )

Includes:

Dog-fish and shark....

Rays....

Characteristics of Subclass:

Habitat and distribution....

Skeleton....

Scales....

Caudal fin heterocercal....

Teeth....

Eggs....

Air bladder....

Gill slits usually five which open separately. No operculum.

2. Subclass: Teleostomi ( )

Includes the more common fishes. Name 10....

Characteristics of Subclass:

Habitat and distribution....

Skeleton....

Scales....

Caudal fin homocercal or diphycercal....

Teeth....

Eggs....

Air bladder....

But one external opening for gill chambers. Operculum present.

3. Subclass: Dipnoi ( )
Includes:

Lung-fishes. . . .

Characteristics of Subclass:

Habitat and distribution. . . .

Skeleton. . . .

Scales. . . .

Caudal fin diphycercal.

Gills. . . .

Lung (explain homology with air bladder). . . .

Operculum present.

Characteristics of Class:

Importance of fishes and distribution. . . .

Organs of locomotion and respiration adapted for aquatic life. . . .

Exoskeleton. . . .

Notochord and skeleton. . . .

Air-bladder. . . .

Teeth. . . .

Temperature of blood. . . .

References. . . .

AMPHIBIA.

2. Class: Amphibia ( ). The Frog.

1. Body:

   a. Shape, portions and color....

   b. Covering....

2. Appendages, Limbs. Number, position and function....

   Anterior limbs....

   Posterior limbs....

   Method of locomotion....

   Position when at rest....

3. Sense Organs:

   a. Eyes and eyelids....

   b. Tympanum and Eustachian tube....

   c. Nostrils....

4. Mouth:

   Upper jaw. Premaxillary....

   Maxillary....

   Lower jaw. Mandible....

   Teeth. Position, character, use....

   Tongue....

   Glottis....

5. Cloaca—opening at posterior end of trunk....

SKELETON OF FROG. (Label.)

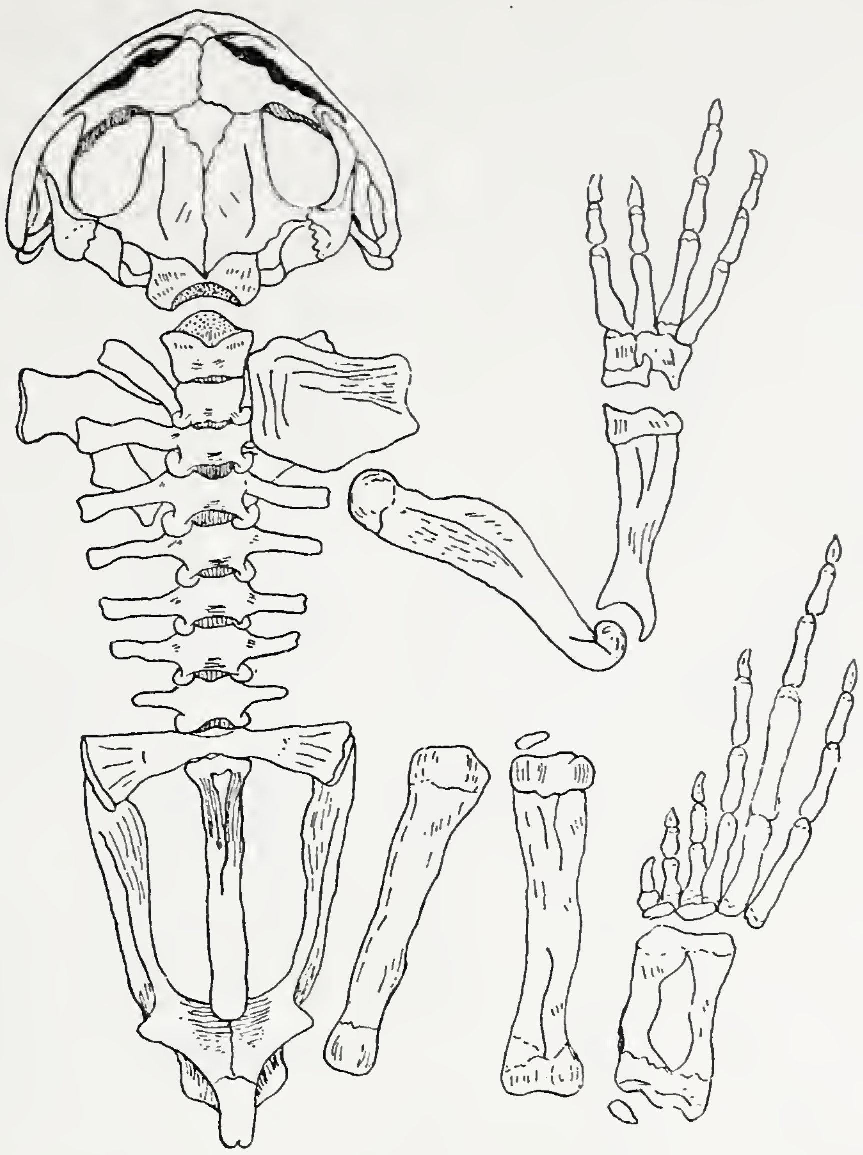

Fig. 6.

1. Axial skeleton.

    Skull and articulation....

    Vertebral column....

        Cervical vertebræ....

        Sacral vertebræ and urostyle....

2. Appendicular skeleton....

    Pectoral or shoulder girdle and fore limb....

        Humerus, radio-ulna, carpals, and phalanges....

    Pelvic girdle and hind limb....

        Femur, tibio-fibula, tarsals, and phalanges....

DIAGRAM OF CIRCULATORY SYSTEM OF FROG. (Color and label.)

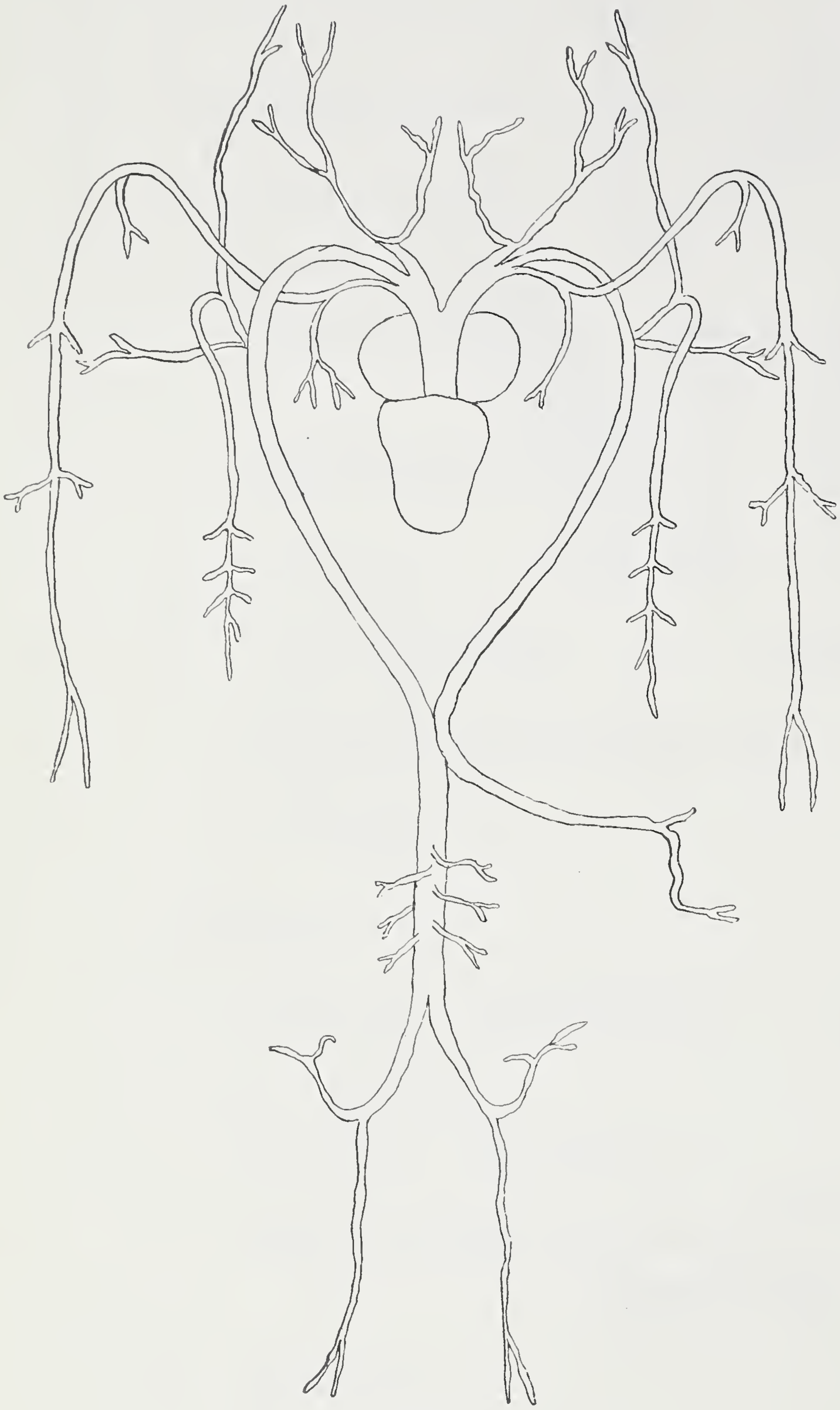

FIG. 7.

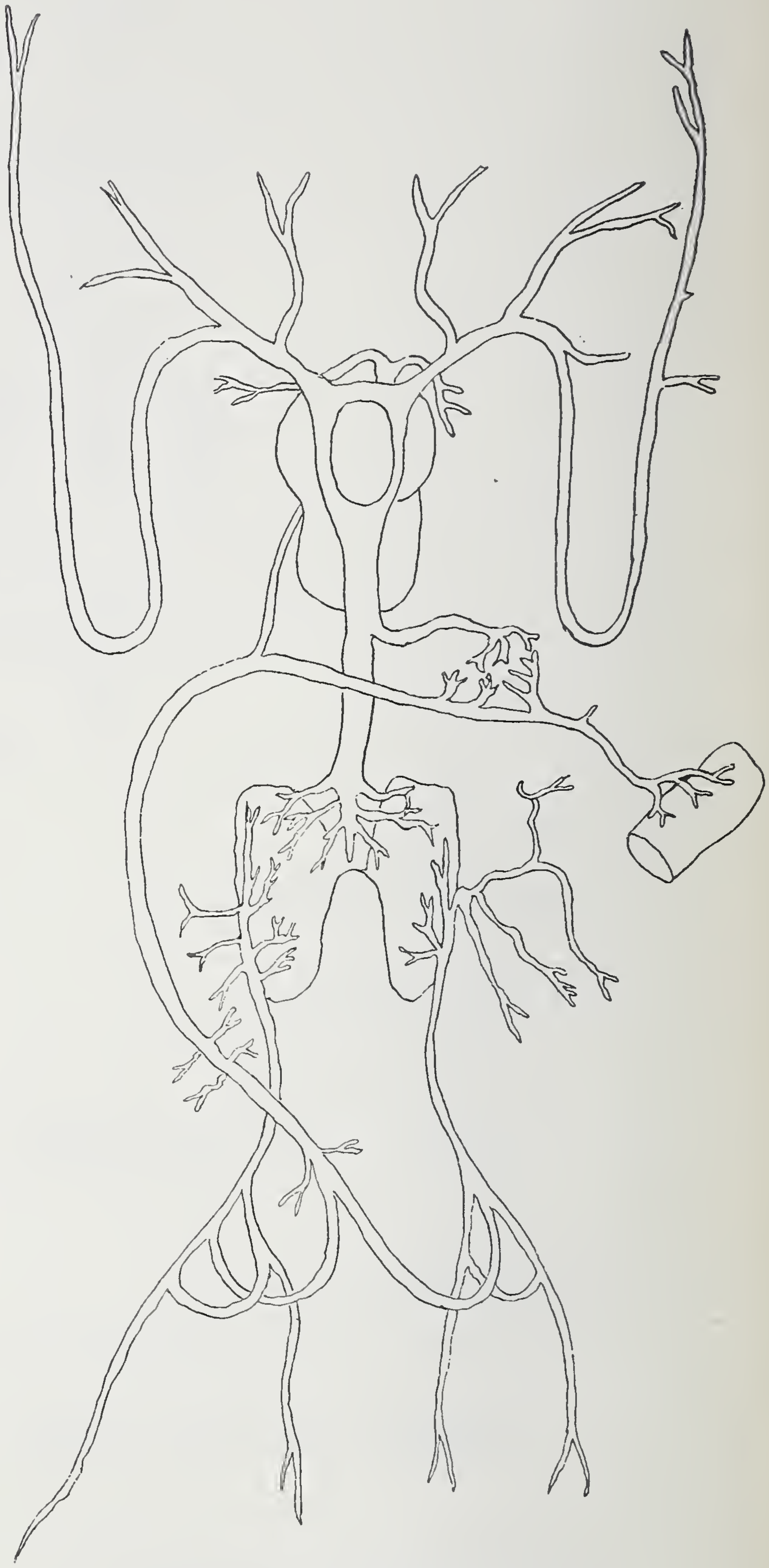

FIG. 8.

INTERNAL ANATOMY OF FROG.

Review body cavity, mesenteries, and peritoneum.

1. Digestive System:
    - *a*. Alimentary Tract:
        - Mouth. . . .
        - Pharynx. . . .
        - Œsophagus. . . .
        - Intestine, large and small. . . .
        - Anus. . . .
    - *b*. Glands:
        - Liver, gall bladder, and bile duct. . . .
        - Pancreas and pancreatic duct. . . .

2. Circulatory System:
    - Heart (chambers). . . .
    - Blood vessels. . . .
    - Account of circulation. . . .

3. Respiratory System:
    - Lungs. . . .
    - Method of breathing and process of respiration. . . .

MUSCULAR SYSTEM (identify muscles according to diagrams).

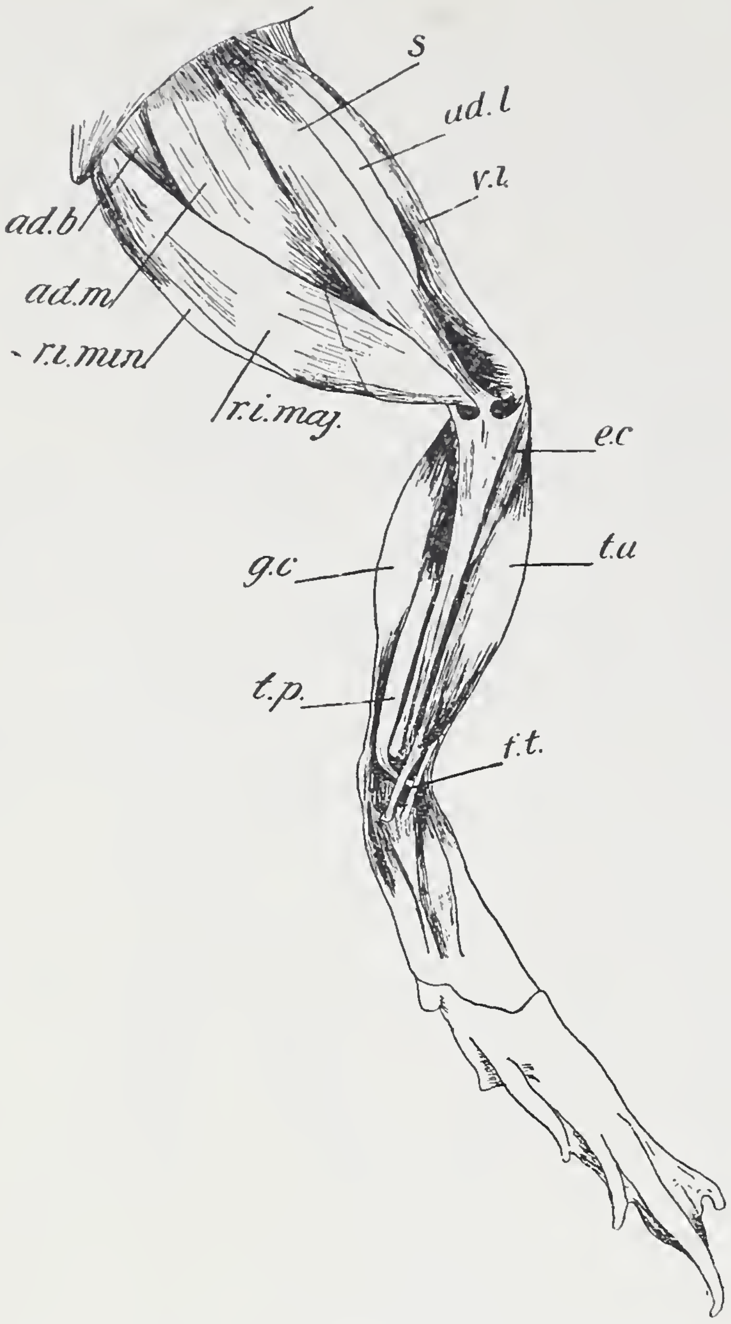

Fig. 9.

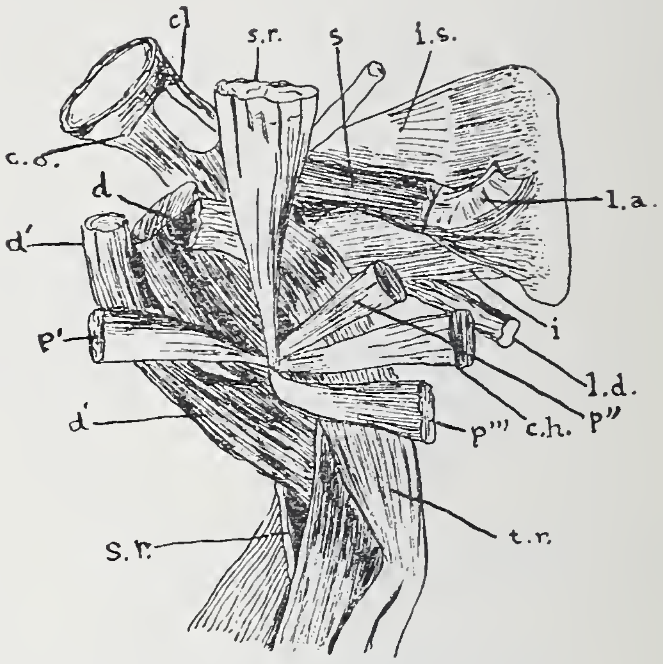

Fig. 10.

5. Urogenital System:

Kidneys, bladder and ureters....

Reproductive organs:

Ovaries and oviducts....

Testes....

Development and life history....

6. Nervous System:

NERVOUS SYSTEM OF FROG (label most important nerves).

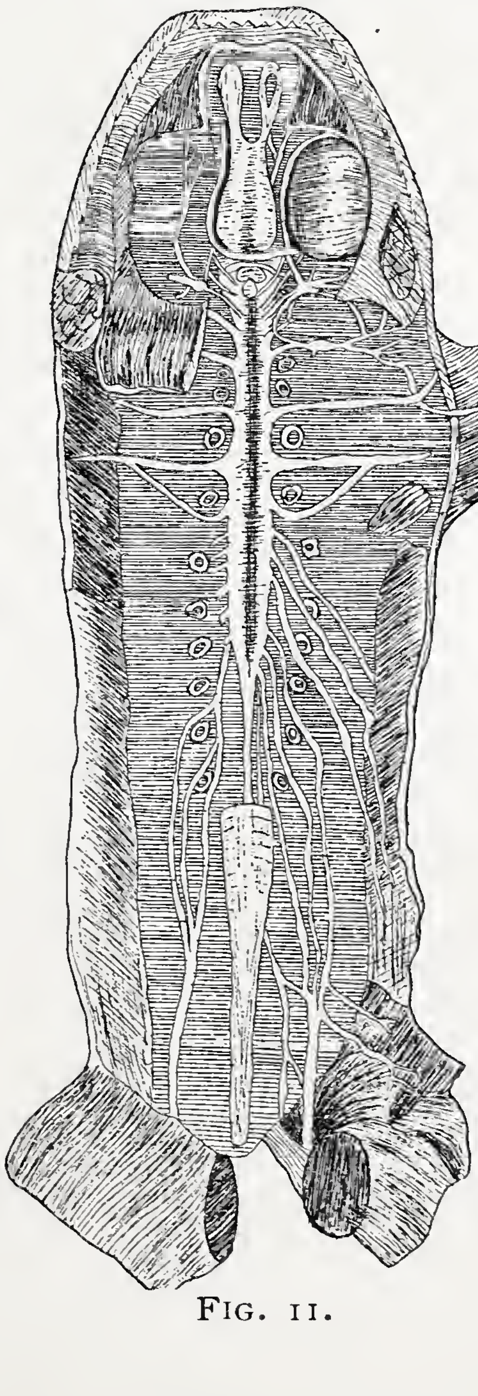

Fig. 11.

7. Spleen. . . .

References :

Ecker, Anatomy of Frog.
Other references. . . .

AMPHIBIA.

2. Class: Amphibia.

  1. Order: Urodela ( )

    Includes:

      Salamander, newt and eft....

      Mud-puppy....

  Characteristics of Order:

    Distribution....

    Habitat and organs of respiration....

    Limbs....

    Tail retained throughout life.

  2. Order: Anura ( )

    Includes....

      Frog....

      Toad....

  Characteristics of Order:

    Distribution....

    Habitat and organs of respiration....

    Limbs and tail....

Characteristics of Class:

    Adaptations for life as to

      (1) Body form and organization....

      (2) Organs of respiration....

      (3) Skin....

      (4) Nostrils....

    Limbs....

    Temperature of blood....

    Articulation of skull....

REPTILIA.

REPTILIA.

DRAWINGS.

3. Class: Reptilia ( )

1. Order: Sauria ( )

Includes:

Lizards....

Characteristics of Order:

Habits, habitat, and distribution....

Limbs....

2. Order: Ophidia ( )

Includes:

Snakes....

Characteristics of Order:

Habits, habitat, and distribution....

Mouth capable of forming wide gape....

Body form and limbs....

3. Order: Crocodilia ( )

Includes:

Alligator and crocodile....

Characteristics of Order:

Habits, habitat and distribution....

Heart....

Body covering....

Lungs are compound sacs. Internal nostrils....

Limbs adapted for. . . .

Quadrate is immovable.
Teeth are lodged in sockets.
Sternum present, also a number of abdominal ribs.

4. Order: Chelonia ( )
Includes:

Turtle. . . .

Tortoise. . . .

Terrapin. . . .

Characteristics of Order:

Habits, habitat, and distribution. . . .

Exoskeleton. . . .

Endoskeleton. . . .

Limbs, two pairs, terminated. . . .

Beak horny, teeth absent.

Quadrate bone immovable.

Lungs compound sacs. Nasal openings united.

Characteristics of Class:

Articulation of skull. . . .

Quadrate bone connects mandible with skull.

Limbs . . . .

Body covering. . . .

Ribs. . . .

Heart, three-chambered. Exception. . . . Blood temperature . . .

Organs of respiration. . . .

Cloaca. . . .

References. . . .

AVES

TOPOGRAPHY OF RIBD. (Label regions.)

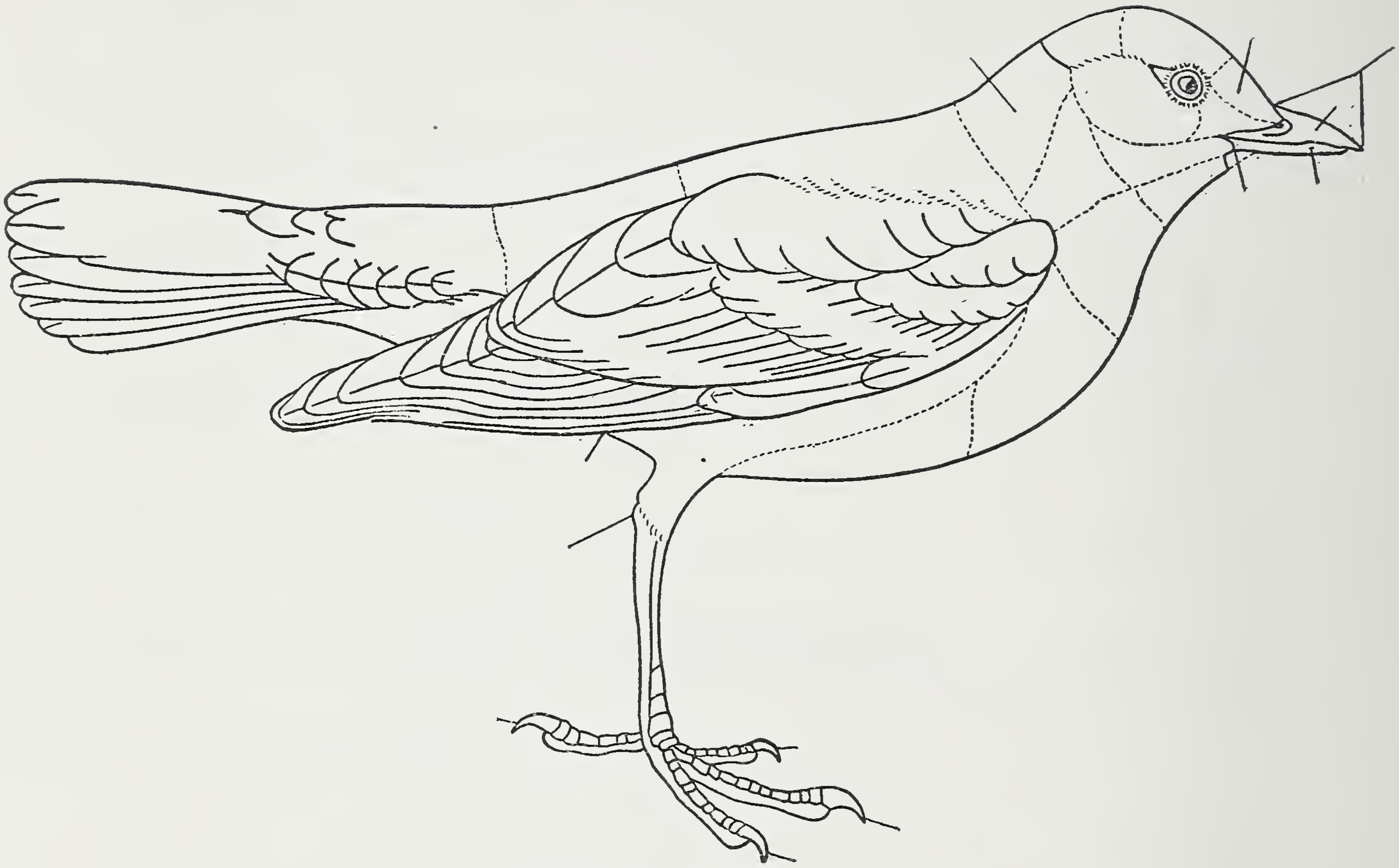

FIG. 12.

1. Body:

General shape....

Head, neck, trunk and tail....

Covering....

Contour feathers....

Down feathers....

Thread hairs....

Drawing of Feather.

Parts of Perfect Feather:

Shaft or scape....

Quill or calamus....

Rachis....

Aftershaft....

Vexillum or vane....

Barbules....

3. Limbs....

4. Sense Organs:

Eyes and eyelids....

Nostrils and cere....

Ears....

5. Openings to exterior:

Mouth....

Cloaca....

6. Oil-gland and preening....

SKELETON.

A. Axial skeleton:

Skull and articulation....

Appendages of skull (mandible or lower jaw and hyoid bone)....

Vertebral column....

Cervical vertebræ....

Ribs....

Thoracic vertebræ....

Ribs....

Synsacrum — fusion of.... thoracic.... lumbar.... sacral.... caudal vertebræ.

Caudal vertebræ....

Pygostyle....

B. Appendicular skeleton:

Shoulder girdle and fore limb....

Scapula....

Coracoid....

Clavicle or wish-bone....

Sternum....

Humerus....

Ulna and rudimentary radius....

Carpals, metacarpals, and phalanges....

Pelvic girdle and hind limb:

Ilium, ischium and pubis....

Femur....

Tibio-tarsus (fibula rudimentary)....

Tarso-metatarsus (rudimentary)....

Phalanges....

INTERNAL ANATOMY.

1. Digestive System:

Mouth (teeth?)....

Tongue ...

Pharynx....

Gullet and crop....

Proventriculus and gizzard....

Small intestine....

Rectum....

Cloaca....

Glands: 1. Liver....

2. Pancreas....

2. Spleen....

3. Circulatory System:

Heart (Chambers)....

Blood Vessels:

Aorta from left ventricle....

Innominate arteries dividing into....

Right and left pulmonary arteries....

Veins....

Character of blood and temperature....

Make Diagram Representing Heart and Principal Blood Vessels.

4. Respiratory System and Vocal Organs:

Larynx....

Trachea....

Bronchii....

Syrinx (how is voice produced?)....

Lungs, describe process of respiration....

5. Muscular System. Special adaptation....

Well developed muscles....

6. Urogenital System:

Kidneys....

Reproductive Organs:

Ovaries and oviduct....

Testes and tube....

7. Nervous System:

Brain....

Olfactory lobes....

Optic lobes....

Spinal cord....

Topics for Papers:
Development, Life History and Habits of Birds.
Birds' Eggs.
Nests and Nest Building.
Migration.
Songs.

References:
Chapman, Bird Life.

Other references....

AVES.

4. Class: Aves ( )

Subclass: Carinatæ ( )

1. Order: Pygopodes ( )

Includes:

Grebe....

Loon....

Auk, Murre, Puffin....

Characteristics of Order:

Habits and habitat....

Special adaptations....

2. Order: Longipennes ( )

Includes:

Gulls and Terns....

Characteristics of Order:

Habits and habitat....

Special adaptations....

3. Order: Tubinares ( )

Includes:

Albatross....

Petrel....

Characteristics of Order:

Habits and habitat....

Bill....

Toes. . . .

4. Order: Steganopodes ( )

Includes:

Cormorant. . . .

Pelican. . . .

Characteristics of Order:

Habits and habitat. . . .

Toes. . . .

5. Order: Anseres ( )

Includes:

Duck. . . .

Goose. . . .

Swan. . . .

Characteristics of Order:

Habits and habitat. . . .

Bill. . . .

Toes. . . .

6. Order: Odontoglossæ ( )

Includes:

Flamingo. . . .

Characteristics of Order:

Habits and habitat. . . .

Bill. . . .

Legs and toes. . . .

7. Order: Herodiones ( )

Includes:

Ibis. . . .

Stork. . . .

Heron and Bittern. . . .

Characteristics of Order:

Habits and habitat. . . .

Legs and toes. . . .

Neck. . . .

Lores. . . .

8. Order: Paludicolæ ( )

Includes:

Crane. . . .

Rail, Gallinule, and Coot. . . .

Characteristics of Order:

Habits and habitat. . . .

Toes. . . .

Bill. . . .

Lores. . . .

9. Order: Limicolæ ( )

Includes:

Snipes and sandpipers. . . .

Plovers. . . .

Characteristics of Order:

Habits and habitat. . . .

Legs and toes. . . .

Bill and nostrils. . . .

Wings. . . .

10. Order: Gallinæ ( )

Includes:

Grouse and partridge....

Pheasants and turkeys....

Curassow and Guan....

Characteristics of Order:

Habits and habitat....

Toes....

Bill....

Wings....

11. Order: Columbæ ( )

Includes:

Pigeon....

Characteristics of Order:

Habits and habitat....

Toes....

Bill and nostrils....

12. Order: Raptores ( )

Includes:

Vulture, Falcon, Hawk and Eagle....

Barn Owl....

Owl....

Characteristics of Order:

Habits and habitat....

Toes....

Bill and nostrils (cere)....

13. Order: Psittaci ( )

Includes:

Parrots and Paroquets....

Characteristics of Order:

Habits and habitat....

Toes....

Bill....

14. Order: Coccyges ( )

Includes:

Cuckoo....

Kingfisher....

Characteristics of Order:

Habits and habitat....

Bill without cere....

15. Order: Pici ( )

Includes:

Woodpeckers....

Characteristics of Order:

Habits and habitat....

Toes....

Bill....

Tail-feathers....

16. Order: Macrochires ( )

Includes:

Goat sucker....

Swift....

Hummingbird....

Characteristics of Order:

Habits and habitat....

Feet....

Bill....

Wings....

17. Order: Passeres ( )

Includes:

Flycatchers....

Larks....

Crows, Jays and Magpies....

Blackbirds and Orioles....

Finches and Sparrows....

Tanager....

Swallows....

Waxwing....

Shrike....

Vireos....

Wood Warblers....

Wren and Thrasher....

Creepers. . . .

Nuthatch and Tit. . . .

Kinglets. . . .

Thrushes and Bluebird. . . .

Characteristics of Order:

Habits and habitat. . . .

Toes. . . .

2. Subclass: Ratitæ ( )

18. Order: Cursores ( )

Includes:

Ostrich. . . .

Rhea, Emu and Cassowary. . . .

Characteristics of Order:

Distribution, habits and habitat. . . .

Limbs. . . .

Wings and feathers. . . .

Characteristics of Class Aves:

Adaptations to environment and habits. . . .

Limbs and body covering. . . .

Respiratory system and temperature of blood. . . .

MAMMALIA.

DRAWINGS.

5. Class: Mammalia (   )

1. Parts of body....

2. Body covering....

3. Limbs and digits....

4. Sense organs....

5. Skeleton:

Axial skeleton.

Skull, articulation and appendages of skull....

Vertebral column....

Appendicular skeleton....

INTERNAL ANATOMY.

1. Digestive System:

Mouth bounded by fleshy lips. Tongue....

Teeth, number, arrangement, and use....

Pharynx....

Œsophagus....

Stomach....

Intestine....

Anus....

Glands....

2. Circulatory System:

Heart, chambers....

Blood vessels and blood temperature....

3. Respiratory System and Vocal Organs:

Epiglottis and glottis....

Larynx....

Bronchial tubes....

Lungs....

4. Muscular System....

5. Excretory Organs....

6. Nervous System:

Brain, cerebrum, cerebellum and medulla oblongata....

Spinal cord....

7. Reproductive System....

Mammals are viviparous. Exception....

Placenta....

5. Class: Mammalia.

1. Order: Monotremata ( )

Includes Duckbill and Spiny Ant-eater. . . .

Characteristics of Order:

Distribution. . . .

Single excretory aperture.
Brain of low and simple type.

2. Order: Marsupialia ( )

Includes Opossum and Kangaroo. . . .

Characteristics of Order:

Distribution. . . .

Possession of marsupium and marsupial bones.
Young born in rudimentary condition.
Two excretory openings surrounded by common muscle.

3. Order: Edentata ( )

Includes Armadillo, Scaly Ant-eater and Sloth. . . .

Characteristics of Order:

Distribution. . . .

Dentition incomplete. Incisors and canines absent. Premolars and molars when present not well developed. No enamel.

Claws adapted for. . . .

Brain small, a step higher than Monotremes, with a few shallow convolutions.

4. Order: Cetacea (   )

Includes:

Whalebone whales....

Sperm whales....

Dolphins and Porpoises....

Characteristics of Order:

Distribution and habitat....

Head, shape of body, and body covering....

Limbs....

Fins, caudal and dorsal....

Nostrils....

Peculiar adaptation of respiratory apparatus....

Spouting....

Teeth....

Eyes and ears....

Brain is large, cerebral hemispheres richly convoluted.

5. Order: Sirenia (   )

Includes: Manatee, Dugong and Rhytina (latter recently extinct)....

Characteristics of Order:

Distribution and habitat....

Body, shape, neck and body covering....

Food....

Limbs and caudal fin....

MAMMALIA.

DRAWINGS.

6. Order: Ungulata ( )

1. Section: True Ungulates.

A. Suborder: Artiodactyla ( ). Even-toed.

RUMINANTS.

1. Deer Family....

2. Antelope Family....

3. Cattle and their Allies....

4. Camel Family....

Characteristics of Ruminants:
Dentition....
Stomach....
Food....
Horns....

NON-RUMINANTS.

1. Pig and allies....

2. Hippopotamus....

Characteristics of Non-Ruminants:

Dentition....

Stomach simple. Food....

Characteristics of Artiodactyla:

Dentition, formula for cow....

Functional digits 4 or 2. In two-toed forms the first, second and fifth are lacking. In four-toed forms the fifth is absent.

MAMMALIA.

DRAWINGS.

B. Suborder: Perissodactyla ( ). Odd-toed.

Includes:

1. Tapir. . . .

1. Rhinoceros. . .

3. Horse and allies. . . .

Characteristics of Suborder:

Distribution and size. . . .

Stomach simple. Food and dentition. . . .

Digits. . . .

2. Section: Subungulates.

C. Suborder: Proboscidea ( )

Includes:

Elephant. . . .

Characteristics of Suborder:

Distribution. . . .

Stomach simple. Food and dentition. . . .

Five functional digits. Feet plantigrade.

Character of skin-Pachyderms. . . .

Proboscis. . . .

Characteristics of Order:

Distribution and habitat. . . .

Horny hoofs. . . .

No clavicle. . . .

Dentition. . . .

7. Order: Rodentia (   )

Includes:

Rabbits and Hares....

Porcupines....

Gophers....

Pocket Mice....

Jumping Mice....

Rats and Mice....

Squirrels....

Beavers....

Characteristics of Order:

Habits and distribution....

Food and dentition (incisors especially)....

Digits....

Size and integument....

Brain....

8. Order: Insectivora ( )

Includes:

Hedgehog. . . .

Shrew. . . .

Mole. . . .

Characteristics of Order:

Habits, habitat and distribution. . . .

Food and dentition. . . .

Feet plantigrade. Digits. . . .

Clavicle present. . . .

Size and integument. . . .

Brain. . . .

9. Order: Chiroptera ( )

Includes:

Leaf-nosed Bats (Vampires). . . .

Common Bats. . . .

Characteristics of Order:

Habitat and distribution. . . .

Food and dentition. . . .

Sense organs. . . .

Special adaptations of pectoral limbs, hind limbs and sternum. . . .

10. Order: Carnivora ( )

a. Suborder: Pinnipedia. Feet modified into....

Eared Seals....

Walruses....

Seals....

Characteristics of Suborder:

Habitat and distribution....

Adaptation of limbs for mode of life....

Dentition....

b. Suborder: Fissipedia. Feet not modified into flippers.

Five toes on all feet.

Weasels, Otters, etc....

Raccoons, etc....

Bears....

Civets....

Five toes on fore feet and four on hind feet.

Wolves and Foxes....

Cats....

Hyænas....

Characteristics of Suborder:

Distribution....

Habitat and adaptation of limbs and claws....

Method of walking (digitigrade and plantigrade)....

Dentition....

Characteristics of Order:

Distribution and habitat....

Digits and locomotion....

Dentition....

Stomach....

Character of brain....

11. Order: Primates ( )

1. Suborder: Prosimii ( )

Includes:

Lemurs....

Characteristics of Suborder:

Habitat, habits and distribution....

Dentition....

Digits (termination)....

Brain....

2. Suborder: Simiæ ( )

Includes:

Marmosets....

Apes of the New World....

Apes of the Old World....

Characteristics of Suborder:
Habitat, habits and distribution....

Dentition and food....

Digits (hallux and pollex)....

Brain....

Orbit surrounded by bony ring.

4. Suborder: Anthropidæ ( )

Includes:

Man....

Characteristics of Suborder....

Characteristics of Order:

Habitat and distribution....

Limbs and digits....

Clavicle....

Stomach....

Brain....

Characteristics of Class Mammalia....

Characteristics of Subphylum Vertebrata...

Characteristics of Phylum Chordata....

References:

Stone and Cram, American Animals....

Other references....

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